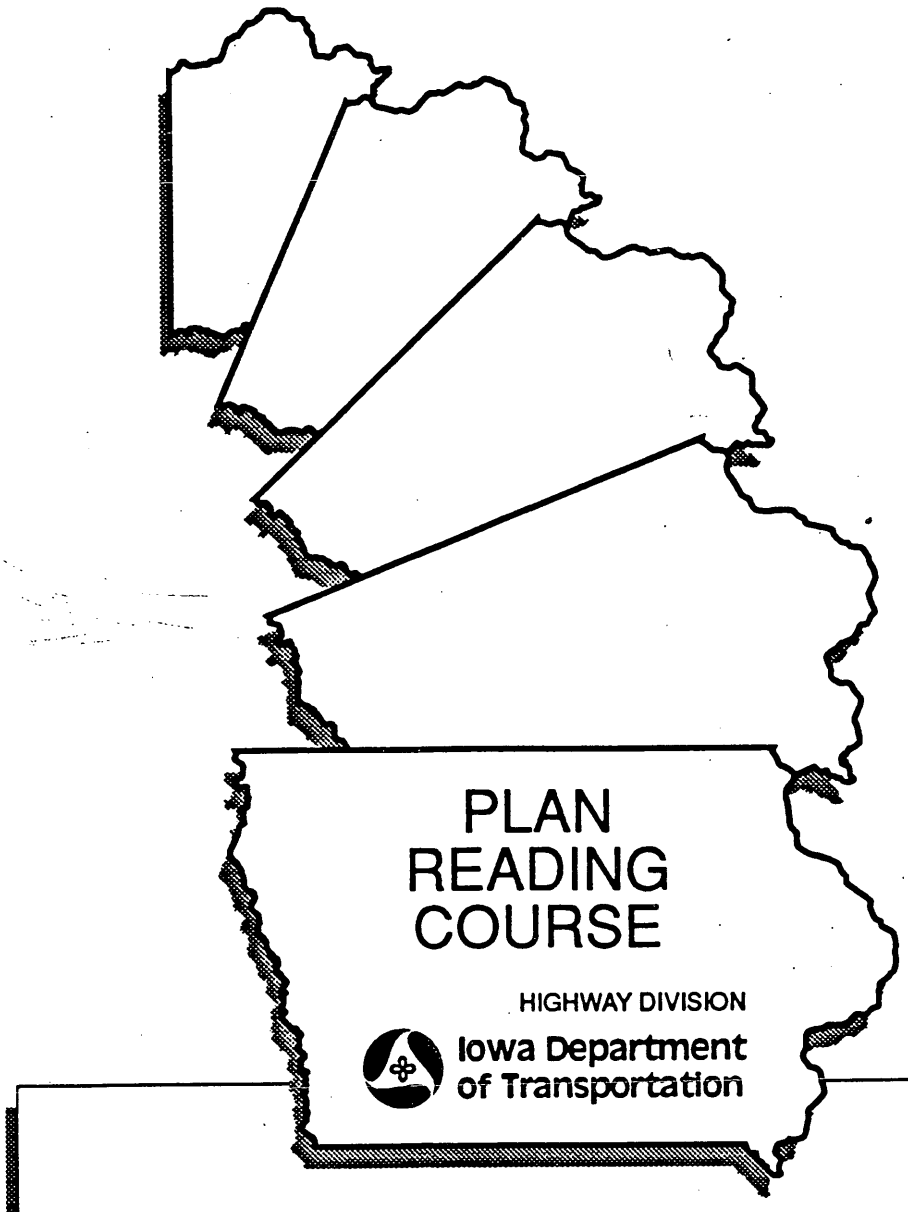
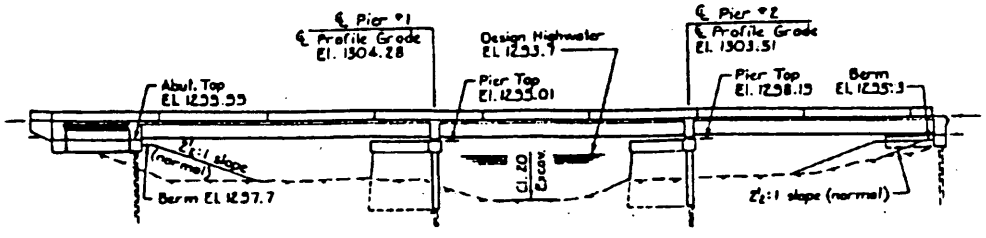


PLAN READING COURSE

HIGHWAY DIVISION

Iowa Department of Transportation



BRIDGE PLANS

QUESTION BOOKLET

HIGHWAY RESEARCH ADVISORY BOARD PROJECT HR324

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Highway Division of the Iowa Department of Transportation.

QUESTION BOOKLET

This booklet is part of the Bridge Plan Reading Course developed by the Department of Civil and Construction Engineering of Iowa State University under contract with the Highway Research Advisory Board, Project HR-324. It is intended to be an instructional tool for Iowa DOT and county and municipal employees within the state of Iowa.

The questions in this booklet are designed to test your knowledge of the material in the Bridge Plan Reading Course. You are free to use both the plans and the text material to assist you in answering these questions. There is a separate **ANSWER BOOKLET** which contains the answers to these questions. Consult that booklet to make sure you have answered these questions correctly. If you miss the answer to a question, go back and review the text material and the plans to make sure you understand the correct answer.

QUESTIONS

GENERAL NOTES AND QUANTITIES

1. What is to be the diameter of the drilled holes for the piling at the east abutment?

2. Where are 6′ lengths of corrugated metal piping (CMP) required?

3. Are quantities for the guardrails included in the total estimated bridge quantities?

4. How many prestressed concrete beams, by type, are required?

5. What is the contractor to do to facilitate passage of vehicular traffic during construction?

6. What is included in item 8 in addition to the 168 l.f. of subdrain?

7. In what bid item is the cost of casing and/or drilling mud to be included?

8. Who has the responsibility of notifying utility companies, who have facilities within the construction limits, of the starting date for construction?

9. What portions of the bridge require epoxy coated reinforcing steel?

10. What provisions have been made by the state for establishing disposal sites and for paying the contractor to haul excess material to these sites?

11. Who obtains title to the old bridge?

QUESTIONS

SITUATION PLAN

1. What are the elevation and station of the east tie-in?

2. What is the elevation of the bottom of the footing for Pier No. 2?

3. What is the length of the steel bearing piling at the east abutment?

4. Is the length of the steel piling at the east abutment the same as the length of the piling for the west abutment?

5. What is the horizontal distance between the east abutment and the centerline of Pier No. 2?

6. What does the 1'-6" refer to in the horizontal dimensions?

7. Is the horizontal distance between Pier No. 2 and the east abutment the same as the distance between Pier No. 1 and the west abutment?

8. What is the horizontal distance between the centerline of Pier No. 2 and the center of the easternmost deck side drains?

9. Is the spacing between deck side drains uniform along the bridge?

10. What is the existing ground elevation at station 658 + 00 at the center of the south rip rap?

QUESTIONS

GENERAL PLAN AND SOUNDINGS

1. What soil material exists at the elevation of the bottom of the footing for the east abutment?

2. What material exists at the south end of the bottom of the footing for bridge Pier No. 2?

3. In examining Design Sheet 2 and the data for TH 1472 and TH 1473 on Design Sheet 3, can you determine why the length of the piling is different at each abutment?

4. Will any dewatering be required to keep water out of the excavation for the footing for Pier No. 1?

5. Is the station of centerline of the existing bridge different from that of the new bridge?

QUESTIONS

PIERS NO. 1,2 DETAILS

The questions below all pertain to Pier No. 2.

1. Describe the 5f4 bars; indicate where they are found, and indicate how many of them there are in this pier.

2. How much concrete cover is required over the top and over the ends of the 5f3 bars?

3. Describe the 8d2 bars; indicate where they are found, how many there are in this pier, and how far above each footing they extend.

4. What is the elevation of the bottom of the south footing?

5. How many 12" x 3" x 1'-0" keyways are there on this pier?

6. What happens if the contractor over-excavates to elevation 1020 ft. for the footings?

7. What is the depth of each step of the bearing surface of the pier cap?

8. What is the difference between the 5c1 and 5c2 bars?

9. Are the bearing plates on the east side of the pier cap the same size as the bearing plates on the west side?

10. What is the elevation of the pier top?

11. How long are the keyways formed by beveled 2" x 8"s in the top of the pier cap?

12. How many cubic yards of concrete are estimated to be required for the columns in Pier No. 2?

13. What is the class of concrete that is to be used for this pier?

QUESTIONS

ABUTMENT DETAILS

1. What is the elevation of the bottom of the east abutment footing?

2. Are the **5d2** bars epoxy coated?

3. What is the minimum embedment length for the **8g1** and **8g2** bars?

4. What is the length of the horizontal leg of the **5k1** bars?

5. What is the depth of the paving notch?

6. What are the shapes, dimensions, and quantity of the **5d5** bars, and where are they located?

7. How is the pay limit for Class 20 excavation for the abutment footing shown?

8. What is required to be done to exposed corners of 90° or sharper?

9. What is required of the west abutment piles that is not required of the east piles?

10. How far in from the north end of the abutment is the centerline of the first beam?

11. What is the elevation of step "A" for the east abutment?

12. What is the spacing between beams?

13. Describe the spirals at the top of each pile.

QUESTIONS

SUPERSTRUCTURE DETAILS

1. What is the width of the roadway?

2. How far below the top of the crown is the surface of the bridge deck slab at the inside toe of the barrier rail?

3. Does the outside of the barrier rail correspond to the outside of the bridge deck slab?

4. How far does the bridge deck slab extend past the centerline of the outer beams?

5. Are the **6b3** and **6b4** bars the same length?

6. What are the maximum and minimum thickness of the bridge deck slab at the outside of the exterior beams?

7. How many **5r1** bars are there? How long are they? Are they epoxy coated?

8. What is the elevation of the top of the bridge deck slab at grid intersection **G14**?

9. What is the anticipated camber, after the slab is in place, for the western-most beams?

10. What is the slab thickness at the beams, 11'-8" west of the centerline of the east abutment?

11. How many 5e1 hoops are there in each pier diaphragm?

12. How is the formwork for the slab to be supported?

13. What clearance is required between the top of the slab and the 5e1 hoops?

14. What clearance is required between the bottom of the slab and the bottom of the 6a1 bars in the bottom mat?

15. Is the south side of the superstructure any different from the north side?

16. How are the top and bottom reinforcing bars in the slab to be supported?

QUESTIONS

INTERMEDIATE DIAPHRAGM DETAILS

1. What is the midpoint for the A46 beams?

2. Which leg of the angle is attached to the beam; the 6 inch leg or the 4 inch leg?

3. How are the bolt holes made in the precast beams?

4. What is the length of the threads of the bolts used to attach the angles to the webs of the precast beams?

5. What is the web thickness of each type beam?

6. What is the length of the bolts connecting the diaphragms to their respective angles?

7. What is the length of the bolts connecting the angles to the beams?

QUESTIONS

BARRIER RAIL DETAILS

1. How many each of the 5c1 and 5c4 bars are in the barrier rails?

2. Why does the "x" dimension vary on the 5c5-5c10 bars?

3. What is the minimum depth of the bead of sealant that is to be along the perimeter of the construction joint between sections of the barrier rail?

4. Which reinforcing bars in the barrier rails are to be epoxy coated?

5. Is the top of the barrier rail to be perfectly level in the longitudinal direction?

6. How many lengths of 5d1 bars are required to span the length of the standard barrier rail section?

7. Using the answer from 6 above, and using the total number of 5d1 bars from the table, determine the number of rows of 5d1 bars in each standard section of barrier rail.

8. What joint sealant is specified for the construction joints?

9. How much concrete is estimated to be in the barrier rails?

QUESTIONS

BEAM DETAILS

1. In the transverse section view **BEAM A46**, the ends of five longitudinal bars or strands are shown in a horizontal row, just below the 3e bar. Can you determine what they are?

2. How far beyond the centerline of the bearings does the end of each beam extend?

3. What is the horizontal transverse clear distance between sets of **4b1** bars?

4. How far should the first lifting loop be from the end of the A30 beam?

5. What is the diameter of steel bar used to fabricate the lifting loop for the A30 beam?

6. What is the length of the coil ties for the A55R beams, and how far above the bottom of the beam is the centerline of the coil ties located?

7. What type of steel is required for the lifting loops?

8. What is the distance of the center of the coil ties from the ends of the beams?

9. For the A46 beams, what is the spacing of the **4b2** bars?

10. For the A46 beams, what is the spacing for the **3c1** bars?

11. Account for the 96 ea. **3d** bars in the A46 beams.

12. For the A46 beams, account for the number of **3e** reinforcing bars, and determine their spacing.

13. What is the length of the A55R beams and the distance between bearings?

QUESTIONS

PIER BEARING DETAILS

1. What is to be done to fill in the space between the outside of the galvanized masonry plate and the outside of the A46 beams?

2. What is the distance from the end of any beam to the centerline of the sole plates at that end?

3. What is the exact thickness of the easternmost pintle plate for Pier No. 1? ....for Pier No. 2?

4. What is the exact thickness of the westernmost pintle plate for Pier No. 1? ....for Pier No. 2?

5. What is the distance between the centerline of the pintles (dimension "A") for the A55R beams?

QUESTIONS

PRECAST PRESTRESSED CONCRETE DECK PANEL DETAILS

1. What length stirrup is required if the contractor decides to use the optional stirrups **4b1a** for this bridge?

2. What should be the distance between legs of the optional **4b1a** stirrup for the A55R beams?

3. What is the maximum spacing of the longitudinal grooves in the top surface of the precast panels?

4. What is the spacing of the optional **4b1a** stirrups?

5. How long must the contractor wait after the precast deck panels have been made before they can be used to support the cast-in-place deck slab?

6. Where does the welded wire fabric mat go with respect to the prestressing strands...above or below?

7. What is the initial tension required in the prestressing strands?

8. What surface preparation for the deck panels is required before placing the deck concrete?

QUESTIONS

TWIN BOX CULVERT

SITUATION PLAN, QUANTITIES & NOTES

1. What is to happen to the structural steel beams which are part of the existing bridge at the site?

2. What is the elevation of the floor of the inlet end of the culvert?

3. Who is to do the backfilling of the culvert?

4. What utility company must be notified of the construction starting date?

5. What is the station location of the centerline of the culvert?

6. What is the width of the finished roadway?

7. Is the culvert designed to carry the 100 year water flow?

8. How are the keyways to be formed between the walls and floor?

9. What is to be the design strength, f'_c, of the concrete?

10. What is the clear distance required between the bottom of the lowest steel reinforcing bars and the bottom face of the concrete in the floor?

11. If the contractor chooses to splice the 5a2 bars in the center wall, what is the minimum length of splice required?

12. What is the bolt diameter and what is the spacing for the anchor bolts that anchor the temporary wood beam to the slab?

13. Where are the 5m3 bars found in the structure, and how many of them are there?

14. Where are the 5a2 bars found in the structure, and what is their spacing?

15. What is the length of each barrel end section?

16. How many intermediate barrel sections are there, and how long is each?

17. What is the width and height of each barrel opening?

QUESTIONS

TITLE SHEET AND QUANTITIES AND NOTES

TITLE SHEET

1. What is the Design No. for this bridge?

2. What is the total length of the project?

3. What Standard Road Plans apply to this project, and what are their issue dates?

QUANTITIES AND NOTES

4. Is the bridge contractor to build the guardrail?

5. Where is the Greenstreak sheet drain, or approved equal, to be installed?

6. Which reinforcing bars are to be epoxy coated?

7. What special precautions must the contractor take with respect to traffic on U.S. 20 and the Chicago-Northwestern railroad?

8. Describe the pre-drilling requirement for the abutment piles.

9. What is included in estimate item no. 10?

10. Who installs the concrete slope protection, and how much of it is required?

11. What is the basis (units) for estimating the traffic control on this project?

12. What will be the basis for payment for the sheet drain?

QUESTIONS

SITUATION PLAN, SOUNDING DATA & TRAFFIC CONTROL PLAN

SITUATION PLAN

1. What is the width of the finished roadway in a typical approach section for U.S. 520?

2. At what station is the center of Pier No. 1 located?

3. What is the distance between the centerline of Pier No. 3 and the centerline of Pier No. 2?

4. How many deck drains are there on this bridge, and is there a uniform spacing?

5. What is the elevation of the centerline of existing U.S. 20 at station 1435?

6. What is the distance between the centerlines of the abutment bearings?

7. What is the slope of the abutment subdrain?

8. Does the roadway of this bridge follow a vertical curve?

9. Where is Benchmark #5 located?

10. Approximately what depth of soil must be excavated for the middle footing of Pier No. 2?

11. Do you see any particular need for caution in excavating for the footings for Pier No. 2?

12. Where is Test Hole F-734 located?

13. Does the width of the roadway change in going from the approach roadway to the bridge roadway?

SOUNDING DATA

14. How far below the surface of the ground was the water table when Test Hole F 736 was drilled?

15. Describe the soil at the bottom of Test Hole F 735.

16. What is the exact location of Test Hole F 734?

TRAFFIC CONTROL PLAN

17. Must through traffic be maintained below the bridge at all times?

18. Does the engineer have any say in the location of the contractor's equipment during non-working hours?

QUESTIONS

PIER DETAILS and REINF. BAR LISTS PIERS #1,2,3

1. Determine the location, size, shape (straight or bent), and number of 7b3 bars in Pier No. 1.

2. The top of the pier cap steps down as it goes out from the center of the cap. Is the height of each of these steps the same for Pier No. 1?

3. How far must the steel H-piles extend into the bottom of the reinforced concrete footings?

4. Determine the location, size, shape (straight or bent), and number of 5n1 and 5m1 bars in Pier No. 1.

5. What is the spacing between the girders, measured along the centerline of the pier cap?

6. Is there a difference between the reinforcing shown in **SECTION B-B** and **SECTION C-C**, Design Sheet 4?

7. Describe the spiral reinforcing for Pier No. 1.

8. Is there any difference between the top-most longitudinal reinforcing in the pier cap of Pier No. 1 and that for Pier No. 3?

9. For Pier No. 1, what is the minimum clearance that must be maintained between the outside of the column spiral and the outside surface of the column concrete?

10. What treatment is required for exposed concrete corners, 90° or sharper?

11. In the event of interference between reinforcing steel and anchor bolts, what can be done?

QUESTIONS

ABUTMENT DETAILS

DESIGN SHEET 10

1. What is the vertical distance from the top of the backwall to the top of the paving notch at the centerline of the east abutment?

2. What is the elevation of the bearing surface for the northern exterior girder at the east abutment?

3. What is the elevation of the bottom of the footing of the west abutment?

4. What does 45°06′ represent?

5. What are the surface dimensions of the stepped bearing surface for the interior girders?

6. Determine the number, length and location of the 5m3 bars in each abutment.

7. What is the distance from the front edge to the back of the paving notch shelf?

8. What is the width and the length of the footing for the longer wingwall?

DESIGN SHEETS 11, 12 AND 13

9. Determine the size, shape, and location of the **6d1** bars, and determine if they are epoxy coated.

10. Determine the size, shape and location of the **6h1** bars and determine if they are epoxy coated.

11. Where is the sheet drain to be placed?

12. When is the **MASKWALL** to be poured?

13. Which is accomplished first, the pouring of the backwall or the placement of the girders?

14. What is the height of the lower portion of the backwall at the east abutment?

15. Is the top of the backwall perfectly level in a transverse direction from its back face to its front face?

16. How many lbs of epoxy coated reinforcing steel are estimated to be required for each abutment?

17. The table **ESTIMATED QUANTITIES BOTH ABUTMENTS**, lists **Concrete Sealer, as per Plan**, as one of the bid items. However, in reviewing Design Sheets 10-13, there is no requirement shown for sealer. Where does this requirement appear?

18. What is the diameter of the spirals that surround the tops of the piles in the abutment footings?

19. What class of structural concrete is required for the abutments?

20. Is the length of the maskwall at the north end of the west abutment the same as the length of the maskwall at the south end of the same abutment? What is the length of each?

21. What does the small triangle next to the 5c bars in **VIEWS A-A, B-B,** and **SECTION C-C,** Design Sheet 13 indicate?

This concludes the questions for the section on **ABUTMENT DETAILS.** Be sure you have answered all questions correctly before advancing to the next part of the course, **SUPERSTRUCTURE DETAILS.**

QUESTIONS

SUPERSTRUCTURE DETAILS, DESIGN SHEETS 14, 15, AND 16

1. Where are the drip grooves located?

2. What is the physical size of the stud shear connectors on the structural steel W24x68 abutment diaphragm?

3. What is the longitudinal spacing of the stud shear connectors on the **W24x68** abutment diaphragms?

4. How far from the outside edge of the top flange are the stud shear connectors located on the **W24x68** abutment diaphragms?

5. What is located between the maskwall and the bottom of the bridge deck?

6. What is the distance between the bottom of the **WT4x90** of the intermediate diaphragm and the top of the bottom flange of the girder?

7. At the ends of the intermediate diaphragms, what is the clearance required between the top of the **WT4x90** and the angle?

8. What clearance is required between the topmost reinforcing steel in the bridge deck slab, and the top surface of the deck?

9. Where is the dividing line between Slab Area A and Slab Area B?

10. At the intermediate diaphragms not over piers, what is the distance from the underside of the top flange of the girder to the centerline of the top bolt of the intermediate diaphragm?

11. Can multiple fill plates of different thicknesses be used at a location to fill between structural steel members? For example, if a 5/8" gap exists between two intersecting angles, can the contractor combine one fill plate ½" thick with another which is 1/8" thick to fill that space?

12. Is it necessary to prime the surfaces of structural steel that are going to be in contact with concrete?

13. What is the distance from the centerline of Pier No. 3 to the centerline of girder Splice #6?

14. What is the longitudinal spacing of the intermediate diaphragms connecting to the center girder between Piers No. 2 and 3?

15. What is the maximum anticipated total dead load deflection between Piers No. 2 and 3, and how much of that is due to the weight of concrete only?

QUESTIONS

SUPERSTRUCTURE DETAILS, DESIGN SHEETS 17A-20, 23,24

DESIGN SHEET 17A

1. What is the length of the girder section between splices #2 and #3? Is it the same as the section between Splices #4 and #5?

2. How far from splice #2 is the first transverse row of studs located on the 12" x 3/4" upper flange plate?

3. Describe the stud sizes and spacing for the flange between splices #4 and #5.

4. What is the length of the studs between splices #5 & #6?

5. What is the height and thickness of the web plate used for the ends of the girder, and how does this compare to the web plate at the piers?

6. What size flange-to-web weld is required for a 1½" flange thickness?

DESIGN SHEET 18

7. What is the thickness of the steel used to fabricate the drains?

8. If the temperature at the time of setting the girders is 30°F, what setting should be given to the rocker bearings at Pier No. 1 and Pier No. 3?

9. How far below the bottom surface of the outside girder must the drains extend?

10. How much clearance should exist between the top of each pintle and the top of the cavity in the sole plate into which it fits?

11. How are the 1" x 1" anchor bars attached to the 5" x 3/4" x 7" plates at their ends?

12. What is required to be done to the masonry plates after they have been welded?

DESIGN SHEET 19A

13. What size plates are used to make up the top flange spliced connection at splice #5?

14. What is the bolt spacing for the bottom flange splice at splice #4?

DESIGN SHEET 20

15. What does the weld symbol at SP4, Pier No. 3, indicate?

16. What is the longitudinal distance between bearings for each of the spans?

17. What is the minimum distance that must be maintained at the girders between the abutment bearing stiffeners and the bent plates used for attaching the steel abutment diaphragms?

DESIGN SHEET 23

18. Using Design Sheets 17A and 23, determine the size of the fillet welds used to attach the top and bottom of the intermediate diaphragm stiffeners to the flanges of the northernmost exterior girder between Splice #3 and Pier No. 2?

19. What is the dimension **X**, as shown in **DETAIL A** and **DETAIL B** for the web between Splice #5 and #6?

DESIGN SHEET 24

20. What is required between the bearings and the pier caps?

21. What is the radius of the rocking surface of the rocker bearing, **R4**?

22. Both the rocker and the fixed shoe have two holes in the body of the casing, 2-½" in diameter. What are those holes for?

23. What is the distance from the surface of the abutment or pier cap to the top of the sole plate at each bearing?

24. What are the overall dimensions of the bearing plate MP4P, and how much does it weigh?

25. After the masonry plates, rockers and shoes are in correct location, and anchor bolts have been tightened, what treatment is required for the slotted holes?

26. What is required to be done to the bearing surfaces just prior to erection of the structural steel in the field?

QUESTIONS

SUPERSTRUCTURE DETAILS, DESIGN SHEETS 21,22

DESIGN SHEET 21

1. What is the overall length of the slab ?

2. What is the overall width of the slab?

3. What is the number of 7a1 bars in the top of the slab?

4. Are the 7a3 bars located in the top or bottom of the slab?

5. How much concrete is in Side A of the superstructure?

6. What is the depth of the 5d4 bars, and where are they found?

7. How many 5e1 bars are there, what is their length, and where are they located?

8. What is the length of the shortest 7a3 bars, and how close to the end of the deck slab are they located?

9. Does the permissible longitudinal slab construction joint coincide with the centerline of the bridge roadway?

DESIGN SHEET 22

10. What is the elevation of the top of slab at the south gutter line at the centerline of Pier No. 1?

11. What is the general trend of the bridge deck surface elevations along the centerline of the roadway?

QUESTIONS

EXTRUSION DETAILS

1. What is the maximum specified spacing for the extrusion anchorages?

2. What is the specified depth of the top of the anchorages below the top of the deck?

3. The bolt and cap screw anchorage systems for the 3/8" curb plates are always to be placed on which side of the expansion joint?

4. What requirement, if any, exists for countersinking the cap screws used to anchor the curb plates?

5. What is the minimum grade steel required for the expansion device?

6. Is splicing of the extrusions permissible?

7. How far from the edges of the curb plate are the centers of the holes for the anchorage?

8. What is the minimum clearance that must be provided between the centerline of the hex. nuts used to anchor the curb plates, and the flared areas in the block-outs for the extrusion and neoprene gland?

QUESTIONS

CONCRETE SLOPE PROTECTION, DESIGN SHEET 28

1. What reinforcing is required in the slope protection?

2. What subgrade preparation is required?

3. What is the thickness of the concrete inside the curbs?

4. How much clearance is specified between the pier columns and the concrete?

5. What is the waiting time between the placement of adjacent courses?

6. What is the basis of payment for the slope protection?

7. What feature of the adjacent roadway controls the elevation of the toe of the concrete of the slope protection?